WHAT IS CLAIMED IS:

1. An illumination optical system, comprising:

a luminous intensity distribution converting optical system for converting an illuminance distribution of a light source image into a luminous intensity distribution upon a predetermined plane;

a total reflection type light transmitting element having its light entrance surface disposed substantially in coincidence with the predetermined plane; and

a light collecting optical system for defining an illumination region upon a surface to be illuminated, by use of light from said light transmitting element.

2. An illumination optical system according to Claim 1, wherein the illuminance distribution of the light source image has an intensity which is higher at a portion adjacent to an optical axis than the intensity at a peripheral portion thereof.

3. An illumination optical system according to Claim 1, further comprising a light source, and light source image forming means for forming the light source image by use of light from the light source.

4. An illumination optical system according to

Claim 3, wherein said light source image forming means includes an elliptical mirror having a focal point whereat the light source is disposed, and wherein the light source image is formed at another focal point of said mirror.

5. An illumination optical system according to Claim 3, wherein the light source comprises a Hg lamp.

6. An illumination optical system according to Claim 1, said converting optical system includes first and second lens units having the same focal distance and being disposed so that a distance between principal points of the two lens units becomes equal to the focal distance, and wherein an entrance pupil of the first lens unit is disposed substantially in coincidence with the light source image while an exit pupil of the second lens unit is disposed substantially in coincidence with the predetermined plane.

7. An illumination optical system according to Claim 1, wherein said converting optical system includes an optical rod and a lens unit, wherein a light entrance surface of the optical rod is disposed substantially in coincidence with the light source image, and wherein one focal point position of the

lens unit is disposed substantially in coincidence with a light exit surface of the optical rod, while another focal point position of the lens unit is disposed substantially in coincidence with the predetermined plane.

8. An illumination optical system according to Claim 1, wherein said converting optical system includes a fly's eye lens and a lens unit, wherein a light entrance surface of the fly's eye lens is disposed substantially in coincidence with the light source image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the fly's eye lens, while another focal point position of the lens unit is disposed substantially in coincidence with the predetermined plane.

9. An illumination optical system according to Claim 1, wherein said light transmitting element comprises an optical fiber bundle.

10. An illumination optical system according to Claim 9, wherein the optical fiber bundle has a light entrance face of one of square shape and rectangular shape, and a light exit face of arcuate shape.

11. An illumination optical system, comprising:

a luminous intensity distribution converting optical system for converting an illuminance distribution of a light source image into a luminous intensity distribution upon a predetermined plane;

an optical fiber bundle having its light entrance surface disposed substantially in coincidence with the predetermined plane; and

a light collecting optical system for defining an illumination region upon a surface to be illuminated, by use of light from said optical fiber bundle.

12. An illumination optical system according to Claim 11, wherein the illuminance distribution of the light source image has an intensity which is higher at a portion adjacent to an optical axis than the intensity at a peripheral portion thereof.

13. An illumination optical system according to Claim 11, further comprising a light source, and light source image forming means for forming the light source image by use of light from the light source.

14. An illumination optical system according to Claim 13, wherein said light source image forming means includes an elliptical mirror having a focal

point whereat the light source is disposed, and wherein the light source image is formed at another focal point of said mirror.

15. An illumination optical system according to Claim 13, wherein the light source comprises a Hg lamp.

16. An illumination optical system according to Claim 11, said converting optical system includes first and second lens units having the same focal distance and being disposed so that a distance between principal points of the two lens units becomes equal to the focal distance, and wherein an entrance pupil of the first lens unit is disposed substantially in coincidence with the light source image while an exit pupil of the second lens unit is disposed substantially in coincidence with the predetermined plane.

17. An illumination optical system according to Claim 11, wherein said converting optical system includes an optical rod and a lens unit, wherein a light entrance surface of the optical rod is disposed substantially in coincidence with the light source image, and wherein one focal point position of the lens unit is disposed substantially in coincidence

with a light exit surface of the optical rod, while another focal point position of the lens unit is disposed substantially in coincidence with the predetermined plane.

18. An illumination optical system according to Claim 11, wherein said converting optical system includes a fly's eye lens and a lens unit, wherein a light entrance surface of the fly's eye lens is disposed substantially in coincidence with the light source image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the fly's eye lens, while another focal point position of the lens unit is disposed substantially in coincidence with the predetermined plane.

19. An illumination optical system according to Claim 11 wherein said optical fiber bundle has a light entrance face of one of square shape and rectangular shape, and a light exit face of arcuate shape.

20. An illumination optical system according to Claim 11. wherein said optical fiber bundle comprises a total reflection type optical fiber bundle.

21. An illumination optical system according to

Claim 11, wherein said optical fiber bundle comprises a distributed refractivity type optical fiber bundle.

22. An illumination optical system, comprising:

a luminous intensity distribution converting optical system for converting a luminous intensity distribution of plural light fluxes having different incidence angles into an illuminance distribution upon a predetermined plane;

a total reflection type light transmitting element having its light entrance surface disposed substantially in coincidance with the predetermined plane; and

a light collecting optical system for defining an illumination region upon a surface to be illuminated, by use of light from said light transmitting element.

23. An illumination optical system according to Claim 22, wherein said light transmitting element comprises an optical rod.

24. An illumination optical system according to Claim 22, wherein the plural light fluxes are supplied by a plurality of laser light sources.

25. An exposure apparatus, comprising:

an illumination optical system as recited in any one of Claims 1 - 24; and

a projection optical system for transferring, by exposure, a pattern of a mask as illuminated with said illumination optical system, onto a wafer.

26. A device manufacturing method, comprising the steps of:

applying a resist to a wafer;

transferring, by exposure, a pattern of a mask onto the wafer by use of an exposure apparatus as recited in Claim 25; and

developing the wafer having the pattern transferred thereto.